# Results of the August-September 2001 Washington State Tsunami Survey

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## EXECUTIVE SUMMARY

A survey looking at residents' and visitors' (non-residents) perceptions of tsunami hazards was carried out along the west coast of Washington State during August and September 2001. A total of 436 questionnaires were delivered directly to houses in the six communities of Long Beach, Seaview, Ocean Park, Surfside Estates, Oysterville and Ocean Shores. A further 733 postal questionnaires were sent to random post office box numbers in the communities of Raymond, Hoquiam, Ocean Shores and Westport. In addition a total of 97 interviews were conducted at several West Coast beaches including Long Beach, Seaview, Ocean City, Ocean Shores and Westport. The study is concerned with quantifying people's understanding of tsunami hazards on the Washington coast, their knowledge regarding the Washington State tsunami warning system, their preparedness to deal with tsunami hazards, and collecting information that could be used for baseline measurement. This report presents the results of this survey and discusses their implications for the current status of hazard education and warning effectiveness, and for the development of future strategies for tsunami hazard reduction and preparedness.

The results can be evaluated in terms of four distinct, but related, stages of hazard preparedness. The distinction between these stages is important because they involve different psychological and social processes and require different intervention strategies to achieve change. The four phases for consideration are:

- **Improving the communities' hazard knowledge and risk perception.** This stage can most easily be influenced by public hazard education programs and current initiatives and appeared to be moderately to highly effective. For example, 62% of residents had seen the tsunami hazard zone maps and 76% of residents had heard or received information on tsunami hazards from a range of sources. In addition some 68% of residents reported that they had heard or observed other people preparing for tsunami hazards. However, visitors (non-residents) surveyed were significantly less aware of the tsunami hazard and the warning system. For example, only 19% of visitors had seen the tsunami hazard zone maps and 46% were unaware of the elements of the tsunami warning system.

- **Promoting intentions to adopt preparatory measures.** The data suggest that, despite high levels of hazard awareness, few households or individuals have made the next step and formulated intentions to prepare for the tsunami hazard. Sixty per cent of residents have asked for information on how to prepare and only 12-14% intend to seek out further information. Of those who have seen preparations underway the majority cited the actions of county, state and federal agencies rather than individuals in the communities. In explaining this we have looked at the measures known from previous studies to determine this behavior namely hazard perceptions and cognitions, outcome expectancy and self-efficacy. A positive sign is that outcome expectancy, the notion that a community can make useful preparations, is moderate to high in our communities. Hazard cognition is at moderate level. The survey data implies that self efficacy, the individuals' perception of their ability to play a role, is at moderate levels, whereas other research suggests higher levels may be required to promote an intention to act. This suggests that future initiatives should target improving self-efficacy and hazard cognition to bring about the best results.

- **Converting intentions into actual behavior**. The level of household preparedness for tsunami hazard is variable and at best moderate. Again the data suggests low to moderate success in this area, residents having adopted the simple and routine measures needed to cope with any of a wide range of hazards universally well but are less prepared in terms of measures that are specific to infrequent and large-scale hazardous events like tsunami. Variables within this category are not amenable to change through public education programs alone and require more experimental intervention and social policy initiatives as discussed below. This result is common to surveys of most communities and in no way reflects on the success of the tsunami program to date, which has gone a long way to achieving the primary aim of hazard awareness. Moreover it flags directions for the future.

- **Maintaining capability**. This was not measured by the survey.

The overall conclusion of this study is that the hazard education program to date has been successful in terms of promoting knowledge and awareness of the tsunami hazard amongst coastal Washington residents. Preparedness, perhaps predictably, is lagging behind awareness at this time. The survey points to the need for some additional strategies to deal with the visitor population and the need to augment existing programs with initiatives that translate this awareness into enhanced preparedness.

## 1.0 INTRODUCTION

Over the last two decades an improved understanding of tsunami risk in Washington has emerged from evaluation of both the impact of historic events (Hogan *et al.* 1964, Wilson & Torum 1972) and the paleotsunami record (Atwater 1992, Atwater *et al.* 1995, Walsh *et al.* 2000).

The largest and best recorded historic tsunami to impact the southern Washington coast followed the March 27, 1964, Alaskan earthquake, resulting in damage to bridges, boats and some port facilities along the outer coast, Grays Harbor and Willapa Bay (Walsh *et al.* 2000). Wave heights of up to 14 feet were recorded. In earlier times there is considerable evidence for a large Cascadia subduction zone earthquake and consequent tsunami just over 300 years ago (1700 A.D.) (Atwater 1997). Wave heights in excess of 20 feet and regional subsidence of 5 feet are thought to have affected a wide area of the Washington coast. Based on modeled tsunami inundation from scenarios for two hypothetical earthquakes on the Cascadia subduction zone similar to the 1700 A.D. event, a tsunami hazard map has recently been published as part of the National Tsunami Hazards Mitigation Program (Walsh *et al.* 2000).

Since the mid 1990's the State of Washington, in association with U.S. Natural Tsunami Mitigation Program, have undertaken a wide range of mitigation activities, including extensive public education. These activities are summarized in several recent reports (Bernard 2001, Jonientz-Trisler & Mullin 1999) and are therefore not reviewed in detail in this report. However, the periodic evaluation of the effectiveness of public education programs and the assessment of preparedness is a core aspect of the readiness process.

In this context, a pilot survey of community members' perceptions of tsunami hazards was carried out along the west coast of Washington State (Figure 1) during August and September 2001. This study was concerned with quantifying people's understanding of tsunami hazards, their knowledge regarding the Washington State tsunami warning system, their preparedness to deal with tsunami activity, and providing information that could be used for baseline measurement and for planning future intervention strategies.

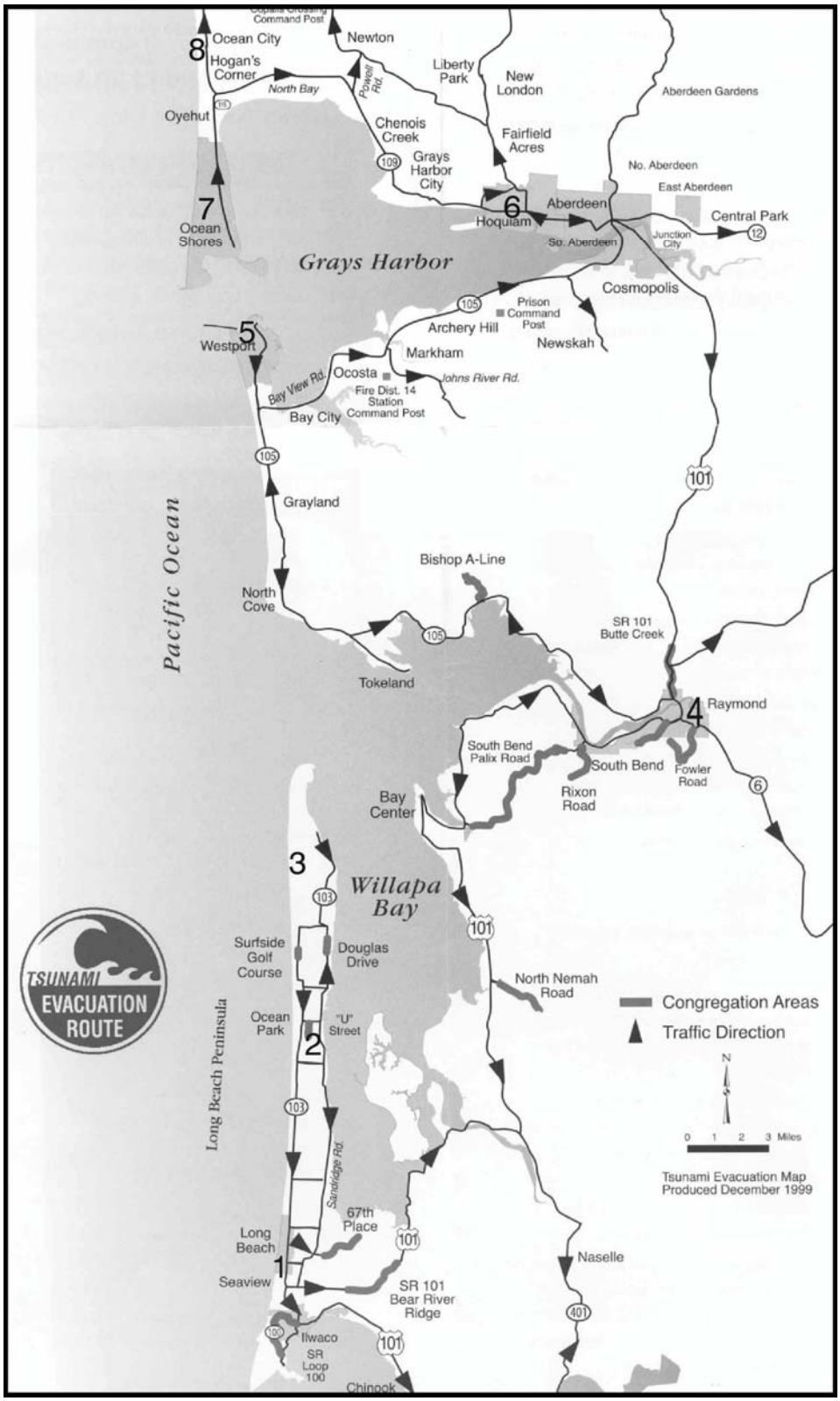


**Figure 1.** Survey locations: 1) Long Beach/Seaview, 2) Ocean Park, 3) Surfside/ Oysterville, 4) Raymond, 5) Westport, 6) Hoquiam, 7) Ocean shores, 8) Ocean City. Map also shows planned evacuation routes as presented in Grays Harbor and Pacific Counties tsunami hazard brochure.

This report presents the results of this survey and discusses their implications for the current status of hazard education and warning effectiveness, and for the development of future strategies for tsunami hazard reduction and readiness.

Following a discussion of the adopted methodology, the report commences with an overview of community receptivity to the public information activities, and their knowledge and understanding of the information made available. This is followed by a review of warning issues.

We then discuss current levels of preparedness. Following an analysis of levels of preparedness, we then review factors that influence peoples' decisions to adopt hazard preparedness measures and actions. This is done in the context of a theoretically robust and empirically tested model that describes preparedness as a process. By using this model, it is possible to systematically assess the different factors that influence preparedness. The use of this approach also helps to identify areas where intervention should be directed, and to describe strategies that could be used to enhance each variable. The data furnished by these analyses also provides baseline data against which subsequent intervention activities can be assessed.

The report concludes with an overview of the key issues identified and outlines a set of practical and research recommendations designed to promote preparedness and ensure that investment in hazard mitigation activities is rendered as effective and efficient as possible.

## 2.0 METHOD

Three different methods were used to collect information: delivering written questionnaires to individual residential houses, using postal (P.O. Box) delivery for questionnaires, and person-to-person interviews with tourists and residents. An explanation of each method follows.

A total of 436 questionnaires were delivered directly to houses in the communities of Long Beach, Seaview, Ocean Park, Surfside Estates, Oysterville and Ocean Shores between 26 August and 1 September 2001 (Table 1). A further 733 postal questionnaires were sent to random post office box numbers in the communities of Raymond, Hoquiam, Ocean Shores and Westport in September 2001 (Table 1). The survey numbers and the location of the

towns were recorded to allow the batches to be identified within a general geographical area, and thus correlate this back to tsunami hazard and community characteristics. A copy of the full questionnaires appear in Appendix 1 and 2.

A total of 97 interviews were conducted at several West Coast beaches including Long Beach, Seaview, Ocean City, Ocean Shores and Westport between 28 August and 30 August 2001 (Table 3). People interviewed were mostly visitors (83) but a small number of residents (14) were also included in the sample. The interviews consisted of eight brief questions (see Appendix 2) that asked about the respondents' knowledge of tsunami hazards in the area and their awareness of the Washington State tsunami warning system. Most visitors were very helpful and willing to undertake the short survey. They were interested in the project and often had questions for us afterwards.

## 3.0 RESULTS

Responses for the total sample are summarized in the remainder of this report. The numbers of valid responses received for each question are indicated. Final percentages of questionnaires returned from each target area are shown in Table 1. Demographic data on the sample is described in Table 2. Information on the date, location and number of interviews can be found in Table 3. Table 4 lists the origin of people interviewed.

**Table 1**. Residents survey return rate.

| Location | Delivered | Returned | Return rate % |
|---|---|---|---|
| Long Beach/Seaview | 306 | 74 | 24.2 |
| Surfside/Oysterville | 126 | 22 | 17.5 |
| Raymond | 103 | 8 | 7.8 |
| Hoquiam | 199 | 30 | 15.1 |
| Ocean Park | 23 | 5 | 21.7 |
| Ocean Shores | 231 | 47 | 20.3 |
| Ocean City | 80 | 7 | 8.8 |
| Westport | 101 | 18 | 17.8 |

According to Table 1, the data obtained provides a moderately representative sample of residents from the area being surveyed. The return rate is low, but is representative of surveys investigating infrequently occurring hazards. Work undertaken in New Zealand (e.g. Ballantyne *et al.* 2000) suggests that the low return rate is indicative of either the low level of

risk attributed to a hazard, low perceived frequency of occurrence, and/or low level of belief in a personal ability to reduce risk through personal endeavor.

It is also interesting to speculate on the implications of the differential rates of return from each area. Rates of return appear, with a few exceptions, to mirror proximity to the ocean, and thus the source of the tsunami hazard. For example, returns are relatively high from areas directly fronting the ocean: Long Beach (24%), Ocean Park (22%), Ocean Shores (20%) and Westport, (18%). Return rates are also high from Hoquiam, which is also exposed to the ocean. The exception to this pattern is Ocean City, which recorded a 9% return rate. Raymond, on the other hand, despite its high objective vulnerability, recorded a return rate of 8%. While more analysis is required to explore this issue, proximity to the hazard may be an important determinant of peoples' perceptions and understanding of tsunami risk. If this assumption proves correct it would be important to accommodate this variable within the risk communication planning process.

**Table 2.** Summary of demographic information of residents.

| **n=211** | **Sample %** |
|---|---|
| Gender | |
| Male | 39.3 |
| Female | 60.7 |
| | |
| **Household type** | |
| Family with children | 23.0 |
| Family without children | 44.6 |
| Alone | 27.5 |
| With non-family | 1.0 |
| Other | 3.9 |
| | |
| Own house | 82.9 |
| Rent | 17.1 |
| | |
| **Ethnicity** | |
| White | 95.5 |
| African-American | 1.5 |
| Asian | 0 |
| Pacific Islander | 0 |
| Hispanic | 0 |
| Other | 3.0 |
| | |
| **Age** | |
| Mean age | 58.2 years |
| Youngest | 22 years |
| Oldest | 92 years |

| | |
|---|---|
| **Employment** | |
| Employed full-time | 36.2 |
| Employed part-time | 17.6 |
| Not in paid employment | 46.2 |
| **Income** | |
| Under $5000 | .2 |
| $5000 to $15 000 | 12.4 |
| $15 001 to $20 000 | 11.4 |
| $20 001 to $30 000 | 15.7 |
| $30 001 to $40 000 | 13.5 |
| $40 001 to $50 000 | 11.9 |
| $50 001 to $60 000 | 7.0 |
| Over $60 001 | 24.9 |
| | |
| **Employment** | |
| No school qualifications | 0 |
| High School graduate | 34.7 |
| Trade certificate or professional certificate or diploma | 27.7 |
| University undergraduate degree | 21.8 |
| University postgraduate degree | 15.8 |

**Table 3.** Date and location of interviews.

| Location | 28 August 2001 (n) | 29 August 2001 (n) | 30 August 2001 (n) |
|---|---|---|---|
| Long Beach | 46 | | |
| Seaview | 7 | | |
| Ocean City | | 3 | |
| Ocean Shores | | | 23 |
| Westport | | | 18 |

**Table 4.** Origin of interviewees.

| Location | n | % |
|---|---|---|
| Locals | 14 | 14.4 |
| Washington (excludes locals) | 62 | 63.9 |
| Arizona | 2 | 2.1 |
| California | 3 | 3.1 |
| Illinois | 1 | 1.0 |
| Maine | 2 | 2.1 |
| North Carolina | 1 | 1.0 |
| New Jersey | 1 | 1.0 |
| New Mexico | 1 | 1.0 |
| Oregon | 8 | 8.2 |
| Tennessee | 2 | 2.1 |

Information on the geographical origin and gender of visitors interviewed is presented in tables 4 and 5.

**Table 5.** Gender of visitors interviewed (only demographic information collected from visitors)

| Gender | Sample % |
|---|---|
| Male | 45.8 |
| Female | 54.2 |

The average length of time residents have lived in their respective communities and in their current house is shown in Table 6.

**Table 6.** Average length of time residents have lived in their respective community and their current house.

| n=211 | Mean number of years |
|---|---|
| In the community | 19.6 |
| In current house | 12.3 |

## 4.0 PUBLIC EDUCATION

Since the late 1990's the State of Washington in association with U.S. Natural Tsunami Mitigation Program has undertaken a wide range of mitigation activities, including extensive public education. Several products (books, posters, pamphlets, school kits, mugs, and magnets) have been jointly produced and distributed amongst the five states involved. In the surveyed communities, warning and evacuation signs were clearly visible (Figure 2).

A number of publications (books, pamphlets and maps) and public displays show maps of the tsunami zone for the southern Washington coast. When asked if they had seen the map, the majority of residents (62.3%) reported they had, with a further 12.3% not being sure (Table 7). This compares to less than a quarter of visitors (24%) who report having seen it or not being sure.

**Table 7.** The proportion of residents and visitors who have seen the tsunami hazard zone maps for the southern Washington coast.

| | Residents % (n=220) | Visitors % (n=83) |
|---|---|---|
| Yes | 62.3 | 19.3 |
| Not sure | 12.3 | 4.8 |
| No | 25.5 | 75.9 |


**Figure 2**. Evacuation signs in the town of Ilwaco. Photo by D. Johnston.

When asked if they had received information on tsunami hazards (Table 8) less than one quarter of residents reported not having heard or received information, with the remaining respondents citing a range of sources from which they had received information. Newspapers or magazines, the County or City Council and television and radio were most commonly mentioned. The residents' response contrasts with that of visitors, for whom the majority (80%) report not to have received any information.

When residents were asked how consistent they thought the information they had received was, less than 10% thought it was inconsistent (Table 9).

Information searching has been shown by researchers (Mileti & Fitzpatrick 1993) to be an important predictor of the success of hazard education campaigns in that the receipt of information often stimulates the respondent to collect additional information from a range of other sources. This information is then used to devise a personal definition of the hazard that respondents are exposed to. However, any additional information is often incorporated into this pre-existing view (perceptions) of the hazard and associated risk (Higgins & Bargh 1987).

**Table 8.** The proportion of residents and visitors who have heard or received any information about preparing for tsunami hazards from a range of sources

| | Residents % (n=225) | Visitors % (n=83) |
|---|---|---|
| I haven't heard or received any information | 24.0 | 79.5 |
| Federal Government | 9.3 | 0 |
| State Government | 12.9 | 0 |
| County or City Council | 41.3 | 0 |
| Police or Fire Service | 15.1 | 2.4 |
| United States Geological Survey | 10.2 | 0 |
| Television and radio | 38.2 | 8.4 |
| Newspapers or magazines | 50.7 | 6.0 |
| Meetings, seminars or workshops | 8.8 | 0 |
| Businesses | 10.2 | 0 |
| School hand-outs | 7.6 | 0 |
| Friends or relatives | 13.3 | 0 |
| Service organizations | 6.7 | 2.4 |
| Where you work | 8.4 | 0 |
| Posters or postcards | 8.8 | 3.6 |
| Telephone book | 8.0 | 0 |
| My insurance company/agent | 2.7 | 0 |
| Other | 10.0 | 32.0 |

**Table 9.** The perceived consistency of tsunami information that residents have received

| n=206 | % |
|---|---|
| I have not heard anything | 18.5 |
| Consistent | 23.2 |
| Fairly consistent | 36.0 |
| Unsure | 11.8 |
| Fairly inconsistent | 3.8 |
| Inconsistent | 4.3 |

Less than a third of residents (~30%) reported actively seeking more information on tsunami hazards (Table 10) and those that had asked a range of sources. The next question (Table 11) asked if people had observed or heard of individuals, groups or organizations preparing for tsunami hazards. Just over half (51.2%) reported the County making preparations. A number of other groups were also cited but almost one third (32.2%) had not observed anyone taking this action.

**Table 10.** Individuals, groups or organizations that residents have asked for information on how to get ready for tsunami hazards.

| | % |
|---|---|
| No, I haven't asked anyone | 69.7 |
| Friends | 9.5 |
| Neighbors | 5.7 |
| Relatives | 5.7 |
| Central government agencies | 2.8 |
| State Government | 4.3 |
| County Government | 11.4 |
| Business establishments | 1.4 |
| My workplace | 4.3 |
| My child's school | 1.9 |
| Other | 3.8 |

**Table 11.** Individual, groups or organizations that residents have observed or heard of getting ready for tsunami hazards.

| n=211 | % |
|---|---|
| No, I haven't seen or heard of anyone getting ready | 32.2 |
| Friends | 7.6 |
| Neighbors | 5.7 |
| Relatives | 6.2 |
| Central government agencies | 11.8 |
| State Government | 22.3 |
| County Government | 51.2 |
| Business establishments | 6.2 |
| My workplace | 6.6 |
| My child's school | 7.1 |
| Other | 8.9 |

## 5.0 WARNING SYSTEMS

Appropriate public response to warnings is vital to minimize loss of life from future tsunami. Warning messages are usually given when a direct response to a threat is required. The response to warnings by individuals has been found to relate to: i) individual risk perception (understanding, belief and personalization); ii) the nature of the warning information (specificity, consistency, certainty, accuracy, clarity, media, frequency etc); and iii) the personal characteristics of the recipient (demographics, knowledge, experience of the hazard, social network, etc) (Mileti & Sorensen 1990, Mileti & O'Brien 1993). The failure of warning systems to deliver timely or accurate warnings, or delivering ones that are responded to inappropriately, can have tragic consequences. The number and diversity of the sources (and, in particular, those relating to recipient demographic characteristics that are immutable over the short term (e.g. age,

socio-economic status) indicate the complexity of the warning process and provide some indication of the problems inherent in trying to design a warning program capable of mobilizing action in communities comprised of diverse groups (Ballantyne *et al.* 2000).

There are many examples described in the literature of people failing to evacuate on receipt of a tsunami warning. In some cases people have moved into high-risk areas to observe the predicted waves. An illustration of this is shown in Figure 3 where a crowd has gathered in Gisborne, New Zealand to watch the arrival of a tsunami from Chile in 1960. In this example the wave behaved more like a rapidly rising tide and no loss of life occurred but the same event killed "sightseers" in Hilo, Hawaii. In these cases recipients of warning messages failed to perceive the significance of the information and respond in an appropriate way. This has implications for warning planning and evaluation. In regard to the former, it implies a need to assess the specific influence of each demographic variable and to design warning messages and activities accordingly. In other words, different warning messages may be required for groups who differ in regard to their demographic or geographic (e.g. Raymond) composition.

**Figure 3**. Residents at Gisborne harbor watching the arrival of the 1960 tsunami. Photo Gisborne District Council.

Tsunami warnings in the Pacific Northwest are provided by NOAA tsunami warning centers in Alaska and Hawaii and passed to local and state emergency management agencies. Since the late 1990's the USGS and NOAA have been working in an enhanced partnership with the five western states to improve warning times under the CREST project (Consolidated Reporting of Earthquakes and Tsunami) (McCreery 2001, Oppenheimer *et al.* 2001).

Another important issue in this context concerns the fact that, in the absence of actual tsunami, data on warning effectiveness remains speculative. Consequently, alternative means are required to evaluate current levels of community members' readiness to respond. Here we examine this issue from the perspective of residents' knowledge of the warning system, its components and its implications. However, as stated above, and irrespective of the levels of knowledge of the systems observed, this does not constitute a valid indicator of likely behavior.

A range of elements believed by residents to make up the State's tsunami warning system is shown in Table 12. Radio and TV announcements and sirens were the most commonly cited elements. As in previous questions visitors were generally less aware than residents (46%) having no knowledge of any of the elements of the warning system (versus 28% of residents). Overall, respondents' knowledge was mixed and indicates a level best described as moderate to high. A need for the development of this aspect of peoples' knowledge is indicated.

Another issue that requires additional analysis in this context is the effect of the visibility of tsunami signs (Figure 2). While providing sound guidance in the event that evacuation is required, their constant presence could encourage a sense of complacency and overestimation of perceived preparedness as a consequence of familiarity with this source of information. This phenomenon has been observed in New Zealand in regard to peoples' familiarity with hazard information in the Yellow Pages (Paton *et al.* 2000). This issue is deserving of additional research.

**Table 12.** Elements which make up the State's tsunami warning system.

| | Residents % (n=225) | Visitors % (n=83) |
|---|---|---|
| Don't know | 27.6 | 45.8 |
| Sirens | 55.2 | 34.9 |
| Loud speaker announcements | 24.0 | 3.6 |
| Flashing lights | 4.9 | 0 |
| Radio and TV announcements | 63.5 | 30.1 |

When asked what to do in the event of receiving a warning (Table 13), the vast majority of both residents (83%) and visitors (74%) knew to move inland and/or to high ground. Visitors were less aware of other actions to take, such as listen to the radio for advice or stay away for at least three hours. Overall, respondents' knowledge can be described as being at moderate to high levels, with some aspects of warning response (e.g. the period for staying out of vulnerable areas and visitor knowledge at low levels) requiring additional attention.

**Table 13.** Residents and visitors perceived actions to take in event of a tsunami warning.

| | Residents % (n=225) | Visitors % (n=83) |
|---|---|---|
| Don't know | 2.2 | 12.0 |
| Stay inside | 0.9 | 0 |
| Run outside and take cover | 0.4 | 0 |
| Go at least ½ mile inland or 100 feet above sea level | 82.6 | 73.5 |
| Watch for the sea waves to come | 1.8 | 0 |
| Stay away from high risk areas for at least 3 hours | 44.0 | 0 |
| Listen to the radio for official advice. | 73.3 | 13.1 |

Residents were more aware than visitors of the agencies responsible for issuing tsunami warnings (Table 14). Just over half of the residents were aware of the roles of the county and city councils (50%) and the police and fire services (56%). Over half of the visitors (53%) didn't know who issued warnings compared to only a quarter (26%) of residents. The data in this table indicates that it is important that agencies provide consistent information and that, if appropriate, the different functions served by different agencies is identified and communicated to the public.

**Table 14.** Residents and visitors understanding of who is responsible for issuing tsunami warnings

| | Residents % (n=225) | Visitors % (n=83) |
|---|---|---|
| Don't know | 26.2 | 53.0 |
| Federal Government | 18.2 | 7.2 |
| State Government | 23.6 | 15.6 |
| County or City Council | 50.2 | 4.8 |
| Police or Fire Service | 55.6 | 8.4 |
| United States Geological Survey | 21.3 | 2.4 |

The perceived response times to a warning or in the event of a coastal earthquake are shown in Tables 15 and 16 for residents and visitors. Around a quarter of both residents (26%) and visitors (28.0%) reported that they did not know how much time they would have to respond if they received a tsunami warning. There was even more uncertainty with respect to the possible time for a tsunami arrival following a felt earthquake with one third of residents (34%) and visitors (33%) reporting not knowing how long they had.

**Table 15.** The time residents and visitors believe they will have to respond if they hear the warning.

| | Residents % (n=217 | Visitors % (n=82 |
|---|---|---|
| Don't know | 25.8 | 28.0 |
| A few minutes | 19.8 | 30.5 |
| 10 minutes to half an hour | 28.6 | 8.5 |
| Half an hour to one hour | 17.1 | 17.1 |
| 1-2 hours | 6.0 | 9.8 |
| More than 2 hours | 2.8 | 6.1 |

**Table 16.** The time residents and visitors believe they will have to respond to an approaching tsunami if they experience an earthquake.

| n=204 | Residents % (n=218) | Visitors % (n=81) |
|---|---|---|
| Don't know | 33.5 | 33.3 |
| A few minutes | 22.9 | 44.4 |
| 10 minutes to half an hour | 22.5 | 3.7 |
| Half an hour to one hour | 11.0 | 12.3 |
| 1-2 hours | 4.6 | 4.9 |
| More than 2 hours | 5.5 | 1.2 |

While not specifically addressed here, these data suggest a need for the additional evaluation of peoples' responsiveness to a felt earthquake (which would require an immediate response) versus tsunami warnings triggered by an event at some point within the Pacific Ocean (where,

in cases of, for example, an event originating in Japan or Chile, the relationship between warnings and actions can be managed more effectively within the time available).

Having reviewed issues relating to public perceptions of warnings and public education programs, this report now addresses the effectiveness of public education and community history of hazard effects to assess the influence of these factors on hazard preparedness.

Overall, current public education initiatives appeared to be moderately to highly effective. For example, data from Table 7 indicated that 62% of residents had seen the tsunami hazard zone maps. According to Table 8, 76% of residents had heard or received information on tsunami hazards from a range of sources, and 59% stated that this is information was consistent (Table 9). Finally, some 68% of residents reported that they had heard or observed other people preparing for tsunami hazards (Table 11). Taken together, if effective public education was the prime determinant of preparedness, high levels of preparedness would be expected from this sample. This proposition is discussed in the next section.

## 6.0 HAZARD KNOWLEDGE, RISK PERCEPTION AND PREPAREDNESS

The primary goal of public hazard education programs is to facilitate household readiness for hazard effects. The adoption of these measures facilitates a capability for coping with the temporary disruption associated with hazard activity and with minimizing damage and insurance costs. Consequently, we now turn our attention to a discussion of the nature and levels of preparedness obtained from the community surveys. A general set of preparedness measures for natural hazards were asked about and these are shown in Table 17. The measures chosen are identical to those used in other recent studies (e.g. Johnston *et al.* 2001).

**Table 17.** Residents levels of household preparedness, for a variety of natural hazards.

| | % |
|---|---|
| Have a working flashlight | 94.3 |
| Protect breakable household items | 19.0 |
| Put strong latches on cabinet doors | 6.6 |
| Store hazardous materials safely | 56.9 |
| Add edges to shelves to keep things from sliding off | 5.2 |
| Strap water heater | 22.7 |
| Install flexible tubing to gas appliances | 11.8 |
| Bolt house to foundation | 31.3 |
| Stockpile water and food for three days | 55.9 |
| Have a working portable radio and spare batteries | 65.9 |
| Have a working fire extinguisher | 69.2 |
| Have a working smoke detector | 87.7 |
| Have a first aid kit | 79.1 |
| Store wrench near gas turn-off valve | 6.2 |
| Pick an emergency contact person outside of the Northwest | 27.5 |
| Someone in family has learned how to put out fires | 50.7 |
| Buy additional insurance (e.g., home) | 33.2 |
| Someone in family has learned to provide first aid | 58.8 |
| Find out if you are in an area particularly vulnerable to a disaster | 57.3 |
| Have home inspected for preparedness | 2.8 |
| Talked to family members about what to do if a tsunami warning is heard | 48.3 |

**Table 18.** Residents levels of insurance cover.

| | n | yes % | no % | don't know % |
|---|---|---|---|---|
| Home insurance | 201 | 89.6 | 10.0 | 0.5 |
| Contents insurance | 199 | 84.9 | 11.6 | 3.5 |

## 6.1 Household preparedness

Overall, with a few exceptions, moderate levels of preparedness were recorded. To more objectively gauge preparedness, however, a distinction should be drawn between:

a) activities likely to be undertaken to routinely safeguard family members, and
b) those required to safeguard the family home and its members from less frequently occurring, but potentially more catastrophic, hazard events (e.g. earthquakes, tsunamis).

Within the former category would be, for example, having a working flashlight (94%), storing hazardous materials (e.g. gas cylinders) safely (57%), having a working portable radio and spare batteries (66%), having a working fire extinguisher (69%) and smoke detector (88%), having a first aid kit (79%), and having someone in family with first aid skills (59%). Because

these represent activities that families may routinely adopt (e.g. because people are very likely to keep a torch and batteries, or have a portable radio, for their daily use, in case of power cuts etc), they do not represent good indicators of specific planning for natural hazard effects. While they do have additional utility in the context of the disruption associated with hazard effects, their presence should not be used as a primary indicator of preparedness. These data can, however, be used as baseline data against which changes in general, routine safety behavior can be gauged.

It is possible to identify activities that are more indicative of family preparedness for infrequent, but potentially more destructive and disruptive hazards. The adoption of these measures facilitates a capability for coping with the temporary disruption associated with hazard activity and with minimizing damage and insurance costs. Also included here would be activities designed to spread risk (e.g. insurance). These activities constitute a more objective basis for the assessment of preparedness for disruptive hazard activity. Under this category (with the proportion of respondents adopting each in parenthesis) would be:

Protect breakable household items (19%)
Put strong latches on cabinet doors (7%)
Add edges to shelves to keep things from sliding off (5%)
Strap water heater (23%)
Install flexible tubing to gas appliances (12%)
Bolt house to foundation (31%)
Stockpile water and food for three days (56%)
Store wrench near gas turn-off valve (6%)
Pick an emergency contact person outside of the Northwest (28%)
Someone in family has learned how to put out fires (51%)
Buy additional insurance (e.g. home) (33%)
Find out if you are in an area particularly vulnerable to a disaster (57%)
Have home inspected for preparedness (3%)
Talked to family members about what to do if a tsunami warning is heard (48%)

When assessed using these measures, levels of preparedness can be described as low to moderate. Areas where preparedness was greatest was in regard to stockpiling food and water, having a family member with knowledge about extinguishing fires (although the level of

expertise is unknown), finding out about the vulnerability of the area to hazards, and discussing what to do if a tsunami warning is heard. Even for these, levels of preparedness are around the 50% mark and there exists substantial scope for improving levels of household preparedness.

These data, taken in conjunction with that described above, suggests that while the public education programs employed in Washington State have been effective in promoting access to pertinent information, so far only limited steps have been taken in actual preparations and appropriate behaviors.

These data are consistent with that from other studies from the US and New Zealand. In interpreting these data, it must be acknowledged that they are drawn from a small sample, and it is possible that levels of preparedness are lower in those who did not respond. Work conducted in New Zealand (Ballantyne *et al.* 2000) would support this conclusion.

**Table 19.** Frequency in which residents check things like food, water and batteries.

| n=203 | % |
|---|---|
| Weekly | 17.1 |
| Monthly | 36.9 |
| Yearly | 28.1 |
| Never | 17.2 |

## 6.2 Perceived preparedness

Another important facet of readiness is the extent to which people perceive themselves, and others, as being prepared. This analysis can identify behavior and attitudes that may be counter-intuitive or contrary to the goals of the program (a possible example of this was given above (where familiarity with tsunami signs may result in perceived over-preparedness), to assess peoples' likely receptiveness to hazard information, to use it to prepare, and to respond to warnings. These issues are discussed in this section.

The data in Table 20 reveal an interesting pattern. With the exception of Local and State Government, respondents tended to rate their preparedness as being significantly better than that of their community as a whole, and household and community preparedness as being better than that of central government.

**Table 20.** Residents perceived levels of preparedness.

| | n | Mean preparedness[1] | s.d. | Don't know % |
|---|---|---|---|---|
| Your household | 202 | 2.41 | 0.82 | 1.9 |
| Your community | 201 | 2.48 | 0.81 | 9.0 |
| Central government | 195 | 2.51 | 0.82 | 20.9 |
| Local/State government | 196 | 2.37 | 0.81 | 18.0 |

1. Scale: 1 = "very prepared", 2 = "somewhat prepared", 3 = "not very prepared", 4 = "not at all prepared", 5 = "don't know".

What is interesting about these data is the fact that individuals, on average, rate themselves as being better prepared than other community members and thus raise an interesting issue. The data in Table 20 are consistent with the operation of an 'unrealistic optimism' bias (Weinstein & Klein 1996; Paton *et al.* 2000; Sjöberg, 2000) whereby respondents are effectively perceiving and rating themselves as less vulnerable and/or more skilful or better prepared than average. This bias is anomalous since individuals cannot all be better than the average for the community as a whole.

This perceptual bias has important implications for the effectiveness of risk communication. Basically, it means that while individuals may be aware of possible shortcomings in preparedness within their community, they do not attribute this to themselves. While individuals may appreciate a need for risk reduction activities, they may be less likely, as a consequence (i.e. they attributed greater existing preparedness to themselves), to act on warnings, adopt preparations recommended to the community as a whole, and participate in community activities presented in public information campaigns. Consequently, irrespective of the quality of the risk communication program, individuals will neither acknowledge nor act on the information and recommendations contained in these initiatives since they are assuming, incorrectly, that it is intended for 'others'.

Overall, the data, particularly in regard to those activities designed to reduce loss and disruption, indicate a need for additional analyses of preparedness. This view is reinforced when data on perceived preparedness, and, in particular, biases in people's beliefs, which will act to reduce perceived risk and the need for preparation. It is to a discussion of reasons why preparedness levels are problematic that this report now turns.

## 6.3 Promoting preparedness

The use of risk management principles to promote preparedness and resilience to hazard consequences is central to contemporary emergency planning. It is often assumed that providing the public with information about hazard activity will automatically result in better preparedness (Smith 1993). However, and irrespective of the quality of the hazard and risk information provided, recent studies have failed to find any links between levels of awareness and/or risk perception and degree of community readiness (Ballantyne *et al.* 2000; Johnston *et al.* 1999 Lindell & Whitney 2000; Paton *et al.* 2000). Indeed, public hazard education programs can effectively reduce preparedness (Ballantyne at al., 2000). The results obtained in this survey are consistent with those obtained in other US and New Zealand studies.

While public education programs that focus on hazard information and activities to promote safety may increase awareness, the actual adoption of risk reduction behavior is influenced by how people interpret and think about hazard issues (Paton *et al.* 2000). Important issues are people's (outcome expectancies) perceptions of whether personal actions will effectively reduce a problem (outcome expectancy) and their beliefs regarding personal capacity to act effectively (self efficacy). In addition, these beliefs influence the effort and perseverance in risk reduction activities, an important factor given the rarity of hazard occurrence and the need for household reduction and readiness activities to be sustained over prolonged periods of time. These factors, and their relationship to risk reduction behavior, are described as a model in Figure 4. This model was derived from an empirical examination of earthquake preparedness in New Zealand. The model provides a framework for the analysis of hazard reduction and readiness activities and for systematically planing future intervention strategies.

In this model, motivation to act is triggered by the perception of a threat, whereas intentions to prepare are driven by perceptions and beliefs. People make assumptions about whether successful outcomes are possible before forming an intention to adopt a preparatory measure. Individuals are more likely to engage in behaviors when the outcome is valued and perceived as achievable. If favorable, the individual moves to a phase strongly influenced by self-efficacy expectations.

This model (Figure 4) illustrates the relationship between risk perception and hazard reduction behavior as a process. It also illustrates the issues that risk reduction strategies must cater for to achieve their goal of promoting and sustaining preparedness. For example, irrespective of the level of perceived risk, people are unlikely to formulate intentions to act if they perceive hazard effects as insurmountable (low outcome expectancy) or perceive themselves as not having the competence to act (low self-efficacy). Even when intentions are formed, they may not be acted on. Several variables capable of moderating the intention-action relationship exist. Whether intentions are converted to actions depends upon people's **interpretation of their past experiences**, their **response efficacy** (appraisal of whether they have the time, resources, skills and social networks required for adoption), their **sense of community** (feelings of attachment for people and places), and whether they **accept personal responsibility** for safety (Ballantyne *et al.* 2000; Bishop *et al.* 2000; Duval & Mulilis 1999; Lindell & Whitney 2000; Paton et al., 2000).

### 6.4 The preparedness process

According to the model below, the preparedness process commences with individual acknowledgement of the existence of hazards in their environment and the extent to which they perceive them as posing a threat to them and/or their livelihood. We commence with an overview of responses regarding hazard knowledge and associated risk perceptions.

When asked about the timing of the last tsunami event to impact their community, a wide range of responses were received (Table 21). Some 28% of residents did not know, 24% thought it had occurred within the last 1000 years, 28% within the last 100 years, and the remainder (13%) either thought that a tsunami had never impacted their community or that it had occurred within the last 10 000 years. A majority of visitors (59.0%) did not know the timing of the last tsunami to impact the coast and some 21% were not aware of their ever having been a tsunami occurrence.

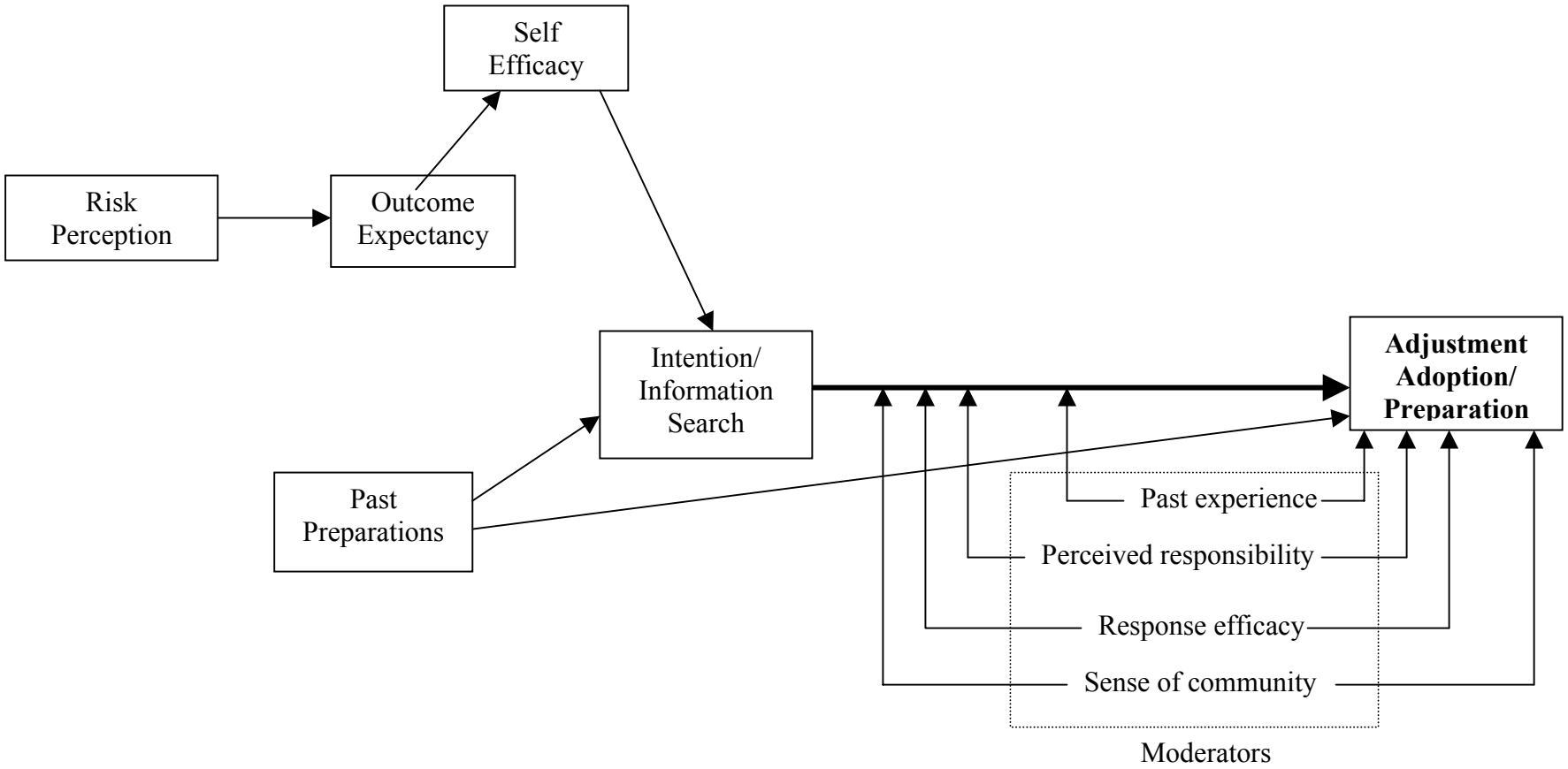


**Figure 4**. The risk perception-preparation model.

**Table 21.** Perceived timing of the last tsunami event to impact on communities.

| | Residents % (n=217) | Visitors % (n=83) |
|---|---|---|
| Never | 11.5 | 20.5 |
| In the last 10 years | 7.8 | 2.4 |
| In the last 100 years | 27.6 | 16.9 |
| In the last 1000 years | 23.5 | 1.2 |
| In the last 10 000 years | 1.4 | 0 |
| Don't know | 28.1 | 59.0 |

According to the data in Table 21, knowledge of the tsunami history of the region is presently at low to moderate levels, with a substantial minority (39%) either not knowing or not believing that a tsunami had ever affected the region. Some 50% had mixed views of this occurrence, and the tendency towards assuming a longer time interval may reduce perceived risk. If these data are considered in relation to those in Table 22, where 63% perceive a high likelihood of tsunami occurrence, the benefits of the latter for encouraging readiness activities may be countered by perceptions of a long return period. This interpretation is borne out by the data in Table 23. Despite being perceived as the second most likely hazard to occur, the timing of tsunami was perceived as either more that 10 years from the present or beyond the lifetime of respondents. While these data must be interpreted cautiously, they suggest that such interactive effects should be examined in more detail in future research and that its hazard educators should not rely on the perceived likelihood of hazard occurrence as being indicative of the awareness of a specific hazard within the community. For example, the perceived time frame for occurrence could reduce the likelihood of people attending to, or acting upon, tsunami hazard information.

When asked about future hazards a majority of residents thought that storms with high winds (75.8%) and tsunami (63.0%) were the most likely future hazards, followed by a minority who believed earthquakes (35.5%) and floods (20.9%) (Table 22). Fire, volcanic eruption, chemical spill or gas leak were mentioned by only a few residents.

When residents were asked the likely timing of potential hazardous events, majority perceived a storm with high winds to occur within the next year (Table 23). Fires were also believed by the majority to be likely to occur in the next year, despite the fact fires were not picked as one of the two most likely hazards in the previous question. Within a ten-year timeframe the majority of respondents also believed that earthquakes were likely. With respect to tsunami 80.7% believed they were likely sometime within their lifetime.

**Table 22.** Residents perceptions of the most likely hazards to affect their communities.

| n=211 | % |
|---|---|
| Flood | 20.9 |
| Storm with high winds | 75.8 |
| Fire | 2.8 |
| Earthquake | 35.5 |
| Volcanic eruption | 2.4 |
| Tsunami | 63.0 |
| Chemical spill or gas leak | 0.9 |
| Landslides | 0.5 |

**Table 23.** Residents perceptions of the likely timing of the next hazard event to affect their community.

| | n | within the next year | within the next 10 years | within your lifetime | not within your lifetime |
|---|---|---|---|---|---|
| Flood | 172 | 15.1 | 36.0 | 20.9 | 27.9 |
| Storm with high winds | 209 | 79.4 | 15.3 | 3.8 | 1.4 |
| Fire | 188 | 57.4 | 18.6 | 17.6 | 6.4 |
| Earthquake | 202 | 22.8 | 55.0 | 17.3 | 5.0 |
| Volcanic eruption | 186 | 0 | 17.7 | 48.4 | 33.9 |
| Tsunami | 197 | 2.0 | 23.9 | 54.8 | 19.3 |
| Chemical spill or gas leak | 178 | 2.2 | 20.2 | 35.4 | 42.1 |
| Landslides | 178 | 2.8 | 24.2 | 14.6 | 58.4 |

## 6.5 Risk perceptions

In their model of hazard preparedness, Paton *et al.* (2001) identified two important precursors of preparedness, risk perceptions and hazard cognitions (the extent to which people discuss and think about hazards). These are discussed in this section.

**Table 24.** Mean responses of residents risk perceptions.

| | n | mean | s.d. |
|---|---|---|---|
| I think a tsunami could pose a threat to my personal safety | 204 | 3.61 | 1.28 |
| I think a tsunami could pose a threat to my daily activities | 203 | 3.69 | 1.29 |

Scale: 1 = “not at all” to 5 = “great deal”

Table 24 describes the next phase in the adoption of hazard reduction activities; the extent to which people perceive the hazard as posing a specific threat to them or to their daily activities. In regard to risk perception, scores of 3.61 and 3.69 indicate moderate to high levels of the potential threat posed by tsunami hazards. If these data are interpreted with those in Table 23,

interaction efforts are signalled. Low preparation could result from high perceived threat interacting with low perceived return periods. This suggests that a new composite measure of risk should be developed.

## 6.6 Hazard cognitions

**Table 25.** Mean ratings of residents' hazard cognitions.

| | n | mean | s.d. |
|---|---|---|---|
| I think about tsunamis | 203 | 2.70 | 1.19 |
| I talk about tsunamis | 204 | 2.42 | 1.07 |

Scale: 1 = "not at all" to 5 = "great deal"

In regard to hazard cognitions, Table 25 indicates moderate levels of thought about and discussing tsunami hazards. Because cognitions exercise a stronger direct influence on the preparedness (Paton *et al.* 2001), these data on cognitions and risk perceptions, collectively, indicate moderate levels of preparedness precursors. There are thus grounds for implicating these factors as contributing to the low to moderate levels preparedness recorded above.

## 6.7 Outcome expectancy

In the model outlined in Table 4, the principal determinant of preparedness was respondents outcome expectancy.

**Table 26.** Residents outcome expectancy.

| | n | mean | s.d. |
|---|---|---|---|
| Tsunamis are too destructive to bother preparing for | 203 | 3.58 | 1.26 |
| A serious tsunami is unlikely to occur during your lifetime | 202 | 3.23 | 1.37 |

Scale: 1 = "strongly agree" to 5 = "strongly disagree"

Table 26 describes the level of outcome expectancy in the sample. These data indicate a moderate to high level of positive outcome expectancy in regard to the likely outcome or value of individual efforts to reduce risk. These data suggest that outcome expectancy could contribute to the low to moderate levels of preparedness described above.

## 6.8 Self efficacy

**Table 27.** Residents self-efficacy.

| | n | mean | s.d. |
|---|---|---|---|
| I feel I have control over the things that happen in my life and in the community | 197 | 3.13 | 1.09 |
| There is no way I can solve some of the problems I have by myself | 193 | 2.80 | 1.35 |
| I can't do much to change what happens in my life or in the community | 197 | 2.28 | 1.16 |
| Somehow problems in my life usually solve themselves | 196 | 2.82 | 1.18 |

Scale: 1 = "disagree strongly" to 5 = "agree strongly"

Another key determinant of intention formation is people's judgement regarding their capabilities to organize and execute courses of action required to achieve objectives or to act in specific ways (self efficacy). The data in Table 27 indicates moderate levels of self-efficacy. This suggests this as a possible factor affecting low intentions and low adoption of risk reduction and protective measures.

Collectively, participants' risk perceptions and cognitions, outcome expectancy and self-efficacy are present at low to moderate levels. On the basis of these scores, low information search and preparatory intentions would be expected. This interpretation is supported by the data in Table 28.

## 6.9 Information search/intentions

**Table 28.** The proportion of residents who intend to seek information or become involved in groups in the next month.

| | No % | Possibly % | Definitely % |
|---|---|---|---|
| Seek information on tsunami risk (n=201) | 50.2 | 37.3 | 12.4 |
| Seek information on things to do to prepare for tsunami (n=204) | 43.6 | 42.6 | 13.7 |
| Become involved with a local group to discuss how to reduce tsunami risk (n=196) | 73.0 | 25.5 | 1.5 |

The data in Table 28 indicate moderate levels of intention to seek information on tsunami risk and mitigation activities, and considerable lower levels of intention to become involved with others to explore reduction options.

The low to moderate levels of information search/intentions observed here would predict the low to moderate levels of risk reduction and preparatory activities observed in Table 17.

### 6.10 Interpretation of prior experience

These are not the only factors implicated in people's decisions regarding the adoption of risk reduction and preparatory activities. The latter is also influenced by several factors that moderate the relationship between intentions and adoption. It is to a discussion of these factors that this report now turns.

Residents were asked if they had personally experienced a range of hazard events and if these events had resulted in significant losses (Table 29). Only storms with high winds (79.6%) and earthquakes (65.9%) had been experienced by a majority of residents. However, only a minority had experienced significant loss or damage from any hazard type. This is significant in that the experience of hazard activity that is not associated with significant losses or disruption can result in a 'normalization bias' (Mileti & O'Brien 1993). This describes how people infer from an ability to cope successfully with (objectively) minor impacts a capability to deal with any future larger occurrence. This bias can result in people overestimating their perceived preparedness and/or underestimating the risk attributed to hazards (Paton *et al.* 2000). Only 6.2% of residents had personally experienced tsunamis and none had reported any loss. Even where hazard experience has been high (e.g. storm, 80%; earthquake, 66%; volcanic eruption, 25%) corresponding low levels of experienced loss or damage (37%, 13%, and 4% respectively) would act to create a generalized normalization bias.

It can be concluded from these data that normalization bias resulting from a combination of high levels of hazard experience, but low levels of experienced loss, may act on Washington residents to reduce the likelihood of preparatory intentions being converted to actual preparation. These data thus provide further insights into the low levels of preparedness observed above. This variable should thus be accommodated in planning future risk reduction strategies.

**Table 29.** Residents who have (a) had a direct encounter of a number of natural events in the past and (b) had experienced significant loss or damage as a result.

| | direct encounter % | loss % |
|---|---|---|
| Flood | 27.0 | 7.6 |
| Storm with high winds | 79.6 | 37.0 |
| Fire | 13.3 | 8.5 |
| Earthquake | 65.9 | 12.8 |
| Volcanic eruption | 24.6 | 3.8 |
| Tsunami | 6.2 | 0 |
| Chemical spill or gas leak | 1.9 | 0 |
| Landslides | 8.5 | 0.9 |

## 6.11 Perceived responsibility

**Table 30.** Residents perceived personal responsibility.

| | n | mean | s.d. |
|---|---|---|---|
| It is unnecessary to prepare for tsunamis as assistance will be provided by the Council and/or the emergency services | 203 | 4.27 | 1.03 |

Scale: 1 = "strongly agree" to 5 = "strongly disagree"

A positive note of the survey is residents' willingness to accept responsibility for tsunami preparation. The data in Table 30 indicates a high level of accepted responsibility amongst respondents and further reinforces the likelihood of people acting to safeguard their well-being. These data suggest that personal responsibility is high and can be discarded as an issue in undermining preparedness. However, it is important that future work continues to reinforce the need for personal responsibility.

## 6.12 Response efficacy

**Table 31.** Factors preventing residents from adopting preparatory measures.

| | n | mean | s.d. |
|---|---|---|---|
| Cost | 184 | 2.49 | 1.37 |
| Skill required to do them | 185 | 2.48 | 1.24 |
| Time to do them | 177 | 2.55 | 1.22 |
| Other things to think about | 168 | 2.55 | 1.30 |
| Need for co-operation with others | 168 | 2.56 | 1.35 |

Scale: 1 = "Not at all" to 5 = "A great deal".

Another moderating factor is respondents perceptions of the physical, time and collaborative resources they have at their disposal (response efficacy). Data in Table 31 indicates moderate constraints for all items and indicates that these factors can undermine preparedness. That is, the data on preparedness (Table 17) should also be interpreted in the context of the data presented in Table 31 regarding response efficacy. Because the adoption of the latter group of preparedness measures require time, money and skill for the adoption and/or implementation, lack of adoption could be attributed, at least in part, to low to moderate response efficacy.

### 6.13 Sense of community

**Table 32.** Residents sense of community.

| | n | mean | s.d. |
|---|---|---|---|
| I feel 'at home' in this community | 196 | 4.11 | 1.03 |
| I am satisfied living in this community | 199 | 3.98 | 1.03 |
| I am a useful member of this community | 193 | 3.38 | 1.33 |
| I have the same values and beliefs as my neighbors | 194 | 3.13 | 1.20 |
| I feel I don't belong in this community | 193 | 1.47 | 0.94 |
| I am interested in knowing what goes on in this community | 195 | 3.95 | 1.11 |
| I would be happy to leave this community | 193 | 1.88 | 1.23 |
| I know my neighbors and/or other community members | 197 | 3.62 | 1.24 |
| I have no active involvement in this community | 194 | 2.15 | 1.29 |

Scale: 1 = "doesn't apply" to 5 = "applies strongly"

Another potential moderating factor concerns the sense of belonging that people have to a place and to others within it; their sense of community. Overall, the data in Table 32 indicates moderate to high levels of sense of community. This characteristic will act to support adoption and reiterates the possibility that it is low perceived likelihood of occurrence that is acting to constrain the adoption of risk reduction measures. These data are consistent with those in Table 6 regarding the time spent within the community and in their current home.

## 7.0 CONCLUSIONS

To achieve the purpose of the study, that is, to understand the current status of hazard education and warning effectiveness and to develop future strategies to improve tsunami hazard reduction and preparedness four distinct, but related, stages of the hazard preparedness process have been identified. Acknowledging the distinction between these stages is important because they involve different psychological and social processes and require different intervention strategies to achieve change. The four phases for consideration are:

- **Improving the communities hazard knowledge and risk perception.** This stage can be influenced by public hazard education programs and current initiatives and appeared to be moderately to highly effective. For example, 62% of residents had seen the tsunami hazard zone maps and 76% of residents had heard or received information on tsunami hazards from a range of sources. In addition some 68% of residents reported that they had heard or observed other people preparing for tsunami hazards. However, visitors (non-residents) surveyed were significant less aware of the tsunami hazard and the warning system. For example, only 19% of visitors had seen the tsunami hazard zone maps and 46% were unaware of the elements of the tsunami warning system.

- **Promoting intentions to adopt preparatory measures.** Some of these factors can be influenced by hazard education programs (e.g. outcome expectancy), but self-efficacy can only be influenced by strategies that focus on community empowerment and require collaboration between, for example, emergency management and social policy agencies. This, in turn, requires attention being directed to inter-agency collaboration. Collectively, residents' risk perceptions and cognitions, outcome expectancy and self-efficacy are present at low to moderate levels. On the basis of these scores, low information searching and preparatory intentions would be expected.

- **Converting intentions into actual behavior**. It is these variables that are the concern of the third phase of intervention. Variables within this category are not amenable to change through public education programs and require more experiential intervention and social policy initiatives. Again the data suggests low to moderate success in this area, such as levels of household preparedness.

- **Maintaining capability**. This was not measured by the survey.

The overall conclusion of this study is that the hazard education program to date has been successful in terms of promoting knowledge and awareness of the tsunami hazard amongst coastal Washington residents. Preparedness, perhaps predictably, is lagging behind awareness at this time. The survey points to the need for some additional strategies to deal with the visitor population and the need to augment existing programs with initiatives that translate this awareness into enhanced preparedness.

## 8.0 SUGGESTIONS FOR FURTHER WORK

The initial survey demonstrated that current risk communication initiatives represent a sound medium for the dissemination of information regarding tsunami risk. The next stage of this project should focus on developing and testing strategies designed to promote warning response, appropriate evacuations behavior and preparedness and ensure that it can be maintained over time. A key aim is to develop a set of key performance indicators for community resilience to the tsunami risk.

We propose here three further initiatives designed to enhance levels of preparedness in the Washington communities. The first is a detailed consultation with key stakeholders to publicize and explore the use of the existing survey data and identify additional issues that need to be considered. The second is to run an assessment of visitor and resident response to the proposed test of the tsunami alert device in Grays Harbor County. The third is an in-depth follow-up survey in 2003.

### 8.1 Survey review and stakeholders consultation

To ensure successful uptake of the results of the first survey, the results should be widely distributed and discussed with all key agencies. This process itself will actually contribute to the goals of the tsunami program by promoting self-efficacy and perceived responsibility by community groups. It should also serve as a springboard for further initiatives by reviewing and enhancing the questions and measures used in the first survey. The Working Group identified a number of extra issues at its March 15 meeting, which can form the nucleus of a larger list of questions arrived at by the stakeholders (Appendix 2). During February-March 2003 a series of focus groups will be organized with state and county emergency management officials, selected groups in the community and other key stakeholders. In these meetings we will explore the results from the pilot survey, evaluate the measures used and identify additional issues to consider in the second survey.

### 8.2 Tsunami alert test

The Tsunami Working Group has agreed to pilot tsunami alert device and this presents a further opportunity to assess the publics' understanding and response to the tsunami warning

system. A coordinated assessment should be undertaken at the time of the test using a number of observers (staff and/or volunteers). During the testing of the device it will useful to conduct a survey of the public in the vicinity of the alert to gain information on the audibility of the message, the visibility of the light and to ask a few general questions about tsunami hazard and warning system.

*Methodology:*

1. Position observers at identified locations away from the alert device.
2. Once the alert is activated the observers will record information about the alert (audibility, clarity of the message, visibility of the lights etc) and the public response.
3. Once the observers have recorded their own observations they will then proceed to interview members of the public in their vicinity, using a standard questionnaire. The observers will also provide information about the warning to reduce the chances of any inappropriate or unwarranted public response.
4. Observers will then report back to a central point to hand over assessment forms and public questionnaires.

### 8.3 Task 4 - Follow-up survey

Following the success of the pilot survey it is proposed that a second survey be undertaken. The format and scope of the second survey will be developed following the focus group meetings and will be guided by their results. A detailed proposal for the second survey will be developed by early 2003 and this will be undertaken in mid to late 2003.

### 8.4 Related research funded by external/federal agencies

There are several other initiatives that are research-focused and funded by external agencies, which will also feed back into the tsunami program. We describe them here to keep our collaborators in the State of Washington aware of developments.

*Strengthening the community resilience model*

A model of community resilience to natural hazard consequences is being developed as part of an international collaboration between researchers from United States, Australia and New Zealand. The data from this survey again indicated that risk perception was a function of a

complex interaction of threat perceptions, return periods, and community preparedness. A measure capable of accommodating these interaction effects is required. Additional work is also required to develop more comprehensive measures of hazard cognitions and outcome expectancy. The results for this survey will feed into further refining the model.

*Education assessments*

Work is currently being undertaken in several schools in Washington to assess children's awareness of volcanic hazards associated with Mount Rainier. During 2002-2004 two high schools are participating in the second phase of the work. It is proposed that this work is extended, working with two (or more) coastal schools. A pilot project will be developed in Grays Harbor and Pacific counties.

### 8.5 Proposed Time line

| | |
|---|---|
| 17-18 July 2002 | David Johnston to meet with George Crawford and Karin Farinell-Hanrahan to scope out education assessment and focus groups. Initiate education assessment is possible. |
| To be set | Alert device test |
| February-March 2003 | Focus groups |

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# APPENDIX 1

# Tsunami Survey



24 August 2001

**Information for participants**

Dear resident,

The University of Hawai'i and Washington State Emergency Management Office are jointly conducting a study of community beliefs about natural hazards, with a special focus on tsunami hazards in Washington State. The findings from the study will be used to help local communities better prepare for future events.

Your household has been randomly selected from households located in coastal parts of Washington State to take part in this very important study. We would like to seek your active participation in helping us with the study, by filling in the enclosed questionnaire and returning it to us.

To understand the range of community views, we need responses from many different types of people - women and men, young and old. In your household, the person who should complete this questionnaire is **the adult (age 18 or older) who most recently had a birthday**.

All replies will be confidential, and we will only report on general trends. Filling in the questionnaire implies that you are consenting to participate. Completing the questionnaire should take about 10 minutes or so of your time. When you have completed it, please put it in the enclosed free return envelope and return it to us.

Your views are very important to the success of this study, and we look forward to hearing from you.

Dr David Johnston
Ms Julia Becker

For further information, please do not hesitate to contact Dr David Johnston at:
phone +64-7-374 8211
email: d.johnston@gns.cri.nz

# NATURAL HAZARD QUESTIONNAIRE - WASHINGTON STATE

1. Which are the **two** most likely hazards that could affect your community?

☐ 1 Flood
☐ 2 Storm with high winds
☐ 3 Fire
☐ 4 Earthquake (Check two only)
☐ 5 Volcanic eruption
☐ 6 Large sea waves (tsunami)
☐ 7 Chemical spill or gas leak
☐ 8 Landslides

2. Have you ever (a) had a direct encounter with any of the following natural events in the past and (b) if you did have an encounter, did you experience significant loss or damage as a result? (tick those that apply):

| | I had a direct encounter | I experienced loss/damage |
|---|---|---|
| Flood | ☐ 1 | ☐ 1 |
| Storm with high winds | ☐ 2 | ☐ 2 |
| Fire | ☐ 3 | ☐ 3 |
| Earthquake | ☐ 4 | ☐ 4 |
| Volcanic eruption | ☐ 5 | ☐ 5 |
| Large sea waves (tsunami) | ☐ 6 | ☐ 6 |
| Chemical spill or gas leak | ☐ 7 | ☐ 7 |
| Landslides | ☐ 8 | ☐ 8 |

3. When do you think the next hazard events are likely to affect your community? (Check one for each hazard)

**Flood**
☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**Storm with high winds**
☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**House fire (in your community)**
☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**Earthquake**
☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**Volcanic ash falls**

☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**Landslides**

☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**Large sea wave (tsunami)**

☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

**Chemical spill or gas leak**

☐ 1 within the next year
☐ 2 within the next 10 years
☐ 3 within your lifetime
☐ 4 not within your lifetime

4. When was the last tsunami that impacted on the location where your community is situated? (Check one only)

☐ 1 Never
☐ 2 In the last 10 years
☐ 3 In the last 100 years
☐ 4 In the last 1000 years
☐ 5 In the last 10 000 years
☐ 6 Don't know

5. For each statement, check the box which best describes your response:

| | Not at all ← *(scale)* → A great deal | | | | |
|---|---|---|---|---|---|
| I think about tsunamis | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I talk about tsunamis | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I get information on tsunamis | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I think a tsunami could pose a threat to my personal safety | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I think a tsunami could pose a threat to my daily activities (e.g., work, leisure or property) | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

6. To what extent do you think that:

| | Strongly agree ← *(scale)* → Strongly disagree | | | | |
|---|---|---|---|---|---|
| Tsunamis are too destructive to bother preparing for | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| A serious tsunami is unlikely to occur during your lifetime | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| It is unnecessary to prepare for tsunamis as assistance will be provided by the State Government/County Government and/or the emergency services | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

7. Have you seen any tsunami hazard zone maps for the Washington Coast? (Check one only)

☐ 1 Yes
☐ 2 Not sure
☐ 3 No

8. Which of following elements make up the State's tsunami warning system? (Check all that apply).

☐ 1 Don't know
☐ 2 Sirens
☐ 3 Loud speaker announcements
☐ 4 Flashing lights
☐ 5 Radio and TV announcements

9. In the event of a tsunami warning, what actions would you take? (Check all that apply).

☐ 1 Don't know
☐ 2 Stay inside
☐ 3 Run outside and take cover
☐ 4 Go at least ½ mile inland or 100 feet above sea level
☐ 5 Watch for the sea waves to come
☐ 6 Stay away from high risk areas for at least 3 hours
☐ 7 Listen to the radio for official advice.

10. Who is responsible for issuing tsunami warnings? (Check all that apply).

☐ 1 Don't know
☐ 2 Federal Government (e.g. FEMA)
☐ 3 State Government
☐ 4 County or City Council (includes local Civil Defense)
☐ 5 Police or Fire Service
☐ 6 United States Geological Survey (USGS)

11. How much time will you have to respond if you hear the warning?

☐ 1 Don't know
☐ 2 A few minutes
☐ 3 10 minutes to half an hour
☐ 4 Half an hour to one hour
☐ 5 1-2 hours
☐ 6 More than 2 hours

12. How much time will you have to respond to an approaching tsunami if you experience an earthquake?

- ☐ 1 Don't know
- ☐ 2 A few minutes
- ☐ 3 10 minutes to half an hour
- ☐ 4 Half an hour to one hour
- ☐ 5 1-2 hours
- ☐ 6 More than 2 hours

**The following set of questions ask about any information you may have received about tsunami hazards or what to do to get ready for it.**

14. Have you heard or received any information about preparing for tsunami hazards from any of the following?

- ☐ 1 I haven't heard or received any information
- ☐ 2 Federal Government (e.g FEMA)
- ☐ 3 State Government
- ☐ 4 County or City Council (includes local Civil Defense)
- ☐ 5 Police or Fire Service
- ☐ 6 United States Geological Survey (USGS)
- ☐ 7 Television and radio
- ☐ 8 Newspapers or magazines
- ☐ 9 Meetings, seminars or workshops
- ☐ 10 Businesses (e.g., pamphlets included with power or phone bills)
- ☐ 11 School hand-outs (e.g., brochures, homework)
- ☐ 12 Friends or relatives
- ☐ 13 Service organizations (e.g., the Red Cross)
- ☐ 14 Where you work
- ☐ 15 Posters or postcards
- ☐ 16 Telephone book
- ☐ 17 My insurance company/agent
- ☐ 18 Other, specify _____

15. In the next month or so, do you intend to:

| | No | Possibly | Definitely |
|---|---|---|---|
| Seek information on tsunami risk | ☐ 1 | ☐ 2 | ☐ 3 |
| Seek information on things to do to prepare for tsunami | ☐ 1 | ☐ 2 | ☐ 3 |
| Become involved with a local group to discuss how to reduce tsunami risk | ☐ 1 | ☐ 2 | ☐ 3 |

16. To what extent might each of the following prevent you from preparing for earthquakes or adopting preparatory measures:

| | Not at all ← *(scale)* → A great deal | | | | |
|---|---|---|---|---|---|
| Cost | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Skill required to do them | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Time to do them | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Other things to think about | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Need for co-operation with others | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Others – specify _____ | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| _____ | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

17. Have you asked any of the following people, groups or organizations for information on how to get ready for tsunami hazards?

☐ 1 No, I haven't asked anyone
☐ 2 Friends
☐ 3 Neighbors
☐ 4 Relatives
☐ 5 Central government agencies
☐ 6 State Government
☐ 7 County or City Council
☐ 8 Business establishments
☐ 9 My workplace
☐ 10 My child's school
☐ 11 Other, specify _____

18. Think about everything you may have heard about tsunami hazards affecting your community. How consistent was this information?

☐ 1 I have not heard anything
☐ 2 Consistent
☐ 3 Fairly consistent
☐ 4 Unsure
☐ 5 Fairly inconsistent
☐ 6 Inconsistent

19. Have you seen or heard any of the following people, groups or organizations doing anything to get ready for tsunami hazards?

☐ 1 No, I haven't seen or heard of anyone getting ready
☐ 2 Friends
☐ 3 Neighbors
☐ 4 Relatives
☐ 5 Central government agencies
☐ 6 State Government
☐ 7 County or City Council
☐ 8 Business establishments
☐ 9 My workplace
☐ 10 My child's school
☐ 11 Other, specify _____

Different people respond to natural disaster in different ways. The next few questions are designed to help us better understand how the community may respond to future hazardous events. Remember all information given will remain confidential.

20. Following is a list of statements on how you feel about living in your community. Please use the scale below to show how much each statement applies to you, or doesn't apply to you.

| | **Doesn't apply** ← **(scale)** → **Applies strongly** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| I feel 'at home' in this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I am satisfied living in this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I am a useful member of this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I have the same values and beliefs as my neighbors | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I feel I don't belong in this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I am interested in knowing what goes on in this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I would be happy to leave this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I know my neighbors and/or other community members | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I have no active involvement in this community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

21. Please think about your life in your community at present. Choose a number from the scale below that shows how much you agree or disagree with each of the following statements.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Disagree strongly | | Neither agree nor disagree | | Agree strongly |

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| I feel I have control over the things that happen in my life and in the community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| There is no way I can solve some of the problems I have by myself | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| I can't do much to change what happens in my life or in the community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Somehow problems in my life usually solve themselves | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

22. Has your family done any of the following to prepare for a hazard or emergency? (check all that apply)

☐ 1 Have a working flashlight
☐ 2 Protect breakable household items
☐ 3 Put strong latches on cabinet doors
☐ 4 Store hazardous materials safely
☐ 5 Add edges to shelves to keep things from sliding off
☐ 6 Strap water heater
☐ 7 Install flexible tubing to gas appliances
☐ 8 Bolt house to foundation
☐ 9 Stockpile water and food for three days
☐ 10 Have a working portable radio and spare batteries
☐ 11 Have a working fire extinguisher
☐ 12 Have a working smoke detector
☐ 13 Have a first aid kit
☐ 14 Store wrench near gas turn-off valve
☐ 15 Pick an emergency contact person outside of the Northwest
☐ 16 Someone in family has learned how to put out fires
☐ 17 Buy additional insurance (e.g., home)
☐ 18 Someone in family has learned to provide first aid
☐ 19 Find out if you are in an area particularly vulnerable to a disaster (e.g., earthquake, flood, chemical spill)
☐ 20 Have home inspected for preparedness
☐ 21 Talked to family members about what to do if a tsunami warning is heard

23. How often do you check things like food, water and batteries?

☐ 1 Weekly
☐ 2 Monthly
☐ 3 Yearly
☐ 4 Never

The next set of questions concerns information about you and your household. Please remember, we will only generalize what is reported (information is anonymous).

24. How prepared do you believe the following are for a tsunami affecting your community?

| | **Very prepared** | **Somewhat prepared** | **Not very prepared** | **Not at all prepared** | **Don't know** |
|---|---|---|---|---|---|
| Your household | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Your community | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Central government | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Local/State government (includes Civil Defense) | ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |

25. Do you, or someone in your house, own or rent the home you live in?

☐ 1 Own or buying
☐ 2 Rent

26. Do you have:

**Home Insurance**
☐ 1 Yes
☐ 2 No
☐ 3 Don't know

**Contents Insurance**
☐ 1 Yes
☐ 2 No
☐ 3 Don't know

27. How long have you lived in your community?

_____ years

How long have you lived in your current home?

_____ years

28. Are you?

☐ 1 Male
☐ 2 Female

29. Which best describes the situation you are living in now?

- ☐ 1 Family with children
- ☐ 2 Family without children
- ☐ 3 Alone
- ☐ 4 With non-family
- ☐ 5 Other, specify _____

30. What ethnic group(s) do you belong to?

- ☐ 1 White
- ☐ 2 African-American
- ☐ 3 Native American/Eskimo/Aleutian Islander
- ☐ 4 Asian
- ☐ 5 Pacific Islander
- ☐ 6 Hispanic (of any race or nationality)
- ☐ 7 Other (please specify)_____

31. How old were you on your last birthday? (Please fill in): _____ years

32. What is you current employment status?

- ☐ 1 Employed full-time
- ☐ 2 Employed part-time
- ☐ 3 Not in paid employment

33. What is your household's gross 2001 income?

- ☐ 1 Under $5000
- ☐ 2 $5000 to $15 000
- ☐ 3 $15 001 to $20 000
- ☐ 4 $20 001 to $30 000
- ☐ 5 $30 001 to $40 000
- ☐ 6 $40 001 to $50 000
- ☐ 7 $50 001 to $60 000
- ☐ 8 Over $60 001

34. What is your highest educational qualification?

- ☐ 1 No school qualifications
- ☐ 2 High School graduate
- ☐ 3 Trade certificate or professional certificate or diploma
- ☐ 4 University undergraduate degree (e.g., diploma or bachelor's degree)
- ☐ 5 University postgraduate degree (e.g., Master's, Ph.D.)

**Thank you for taking the time to complete this questionnaire.**

**Please return the questionnaire in the postage paid envelope provided.**

# APPENDIX 2

# Washington Visitors Survey

## Washington Visitors Survey

Date _____

Survey Location _____

Male Female

**Visitors origin** Local Washington _____

Other state _____

Overseas _____

1. When was the last tsunami that impacted this location ? (Check one only)

- ☐ 1 Never
- ☐ 2 In the last 10 years
- ☐ 3 In the last 100 years
- ☐ 4 In the last 1000 years
- ☐ 5 In the last 10 000 years
- ☐ 6 Don't know

2. Have you seen any tsunami hazard zone maps for the Washington Coast? (Check one only)

- ☐ 1 Yes
- ☐ 2 Not sure
- ☐ 3 No

3. Which of following elements make up the State's tsunami warning system? (Check all that apply).

- ☐ 1 Don't know
- ☐ 2 Sirens
- ☐ 3 Loud speaker announcements
- ☐ 4 Flashing lights
- ☐ 5 Radio and TV announcements

**4. In the event of a tsunami warning what actions would you take? (Check all that apply).**

- ☐ 1 Don't know
- ☐ 2 Stay inside
- ☐ 3 Run outside and take cover
- ☐ 4 Go at least ½ mile inland or 100 feet above sea level
- ☐ 5 Watch for the sea waves to come
- ☐ 6 Stay away from high risk areas for at least 3 hours
- ☐ 7 Listen to the radio for official advice.

5. Who is responsible for issuing tsunami warnings? (Check all that apply).

- ☐ 1 Don't know
- ☐ 2 Federal Government (e.g. FEMA)
- ☐ 3 State Government
- ☐ 4 County or City Council (includes local Civil Defense)
- ☐ 5 Police or Fire Service
- ☐ 6 United States Geological Survey (USGS)

6. How much time will you have to respond if you hear the warning?

- ☐ 1 Don't know
- ☐ 2 A few minutes
- ☐ 3 10 minutes to half an hour
- ☐ 4 Half an hour to one hour
- ☐ 5 1-2 hours
- ☐ 6 More than 2 hours

7. How much time will you have to respond to an approaching tsunami if you experience an earthquake?

- ☐ 1 Don't know
- ☐ 2 A few minutes
- ☐ 3 10 minutes to half an hour
- ☐ 4 Half an hour to one hour
- ☐ 5 1-2 hours
- ☐ 6 More than 2 hours

8. Have your heard or received any information about preparing for tsunami hazards from any of the following?

- ☐ 1 I haven't heard or received any information
- ☐ 2 Federal Government (e.g FEMA)
- ☐ 3 State Government
- ☐ 4 County or City Council (includes local Civil Defense)
- ☐ 5 Police or Fire Service
- ☐ 6 United States Geological Survey (USGS)
- ☐ 7 Television and radio
- ☐ 8 Newspapers or magazines
- ☐ 9 Meetings, seminars or workshops
- ☐ 10 Businesses (e.g., pamphlets included with power or phone bills)
- ☐ 11 School hand-outs (e.g., brochures, homework)
- ☐ 12 Friends or relatives
- ☐ 13 Service organizations (e.g., the Red Cross)
- ☐ 14 Where you work
- ☐ 15 Posters or postcards
- ☐ 16 Telephone book
- ☐ 17 My insurance company/agent
- ☐ 18 Other, specify _____

**Other issues**

_____

_____

_____

_____

_____

_____

_____

## Appendix 3: Issues identified in the meeting of the Local/State Tsunami Working Group, Camp Murray, March 15, 2002.

1) Can an extended study give a more accurate picture of behavior during an event?

2) Amongst residents, are different outreach approaches required for
   (i) Long term residents
   (ii) New residents
   (iii) Summer workers?

   Summer workers may form a key group because in their work they constitute an important source of information for visitors staying in hotels and motels.

3) Will separate strategies be needed for different visitor groups? I.e. could future work break out day visitors from those staying in the area? This would help to develop separate strategies for these groups.

4) While respondents were in general terms aware of the warning system, what do they perceive as the warning system? Do they mislabel single components as the entire system? Is more work needed to make all the parts of the warning system visible?

5) The warning system focuses of timely prior warning of an event. Delivery of the "all-clear" message is equally important. How do people perceive this delivery will occur?